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TERRESTRIAL VERTEBRATES OF ANACAPA ISLAND, CALIFORNIA

BY

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Fig. 1. Location of Anacapa Island, southern California.

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Introduction

This report results from an investigation of the nesting success of birds on Anacapa Island, with special study directed toward the effects of introduced predators. It was expanded to include accounts of all recent terrestrial vertebrate species known to have occurred on the island — 69 birds, five mammals, two reptiles, and one amphibian. The history and status of each is discussed; factors involved in the nesting of certain birds are given particular attention.

Because of a general interest in islands by biologists, and because the Channel Islands are fairly accessible, this group, including Anacapa, has been a focus of attention of scientists from southern California for many years. A number of persons particularly interested in birds visited Anacapa Island in the early decades of the twentieth century. Published reports of their field work and examination of the material they collected have provided the data to which more recent observations have been compared.

Anacapa Island is the northeastern member of the Channel Islands off southern California. It lies about 20 miles southwest of Ventura and 30 miles southeast of Santa Barbara (fig. 1). Anacapa is really a five mile long chain of three east to west trending islets, referred to herein as East, Middle, and West islands. The average width is about one-half mile. All three islets are rugged and steep, with most of the south sides being high cliffs. West Island is the largest and highest (rising to slightly over 900 feet), the one to which the major effort of field work was directed, and the most used by visitors to the Channel Islands National Monument, of which Anacapa Island constitutes the northern portion.

Canalino Indians lived on Anacapa Island when California was discovered and settled by Europeans. Since the Indians left the island, it has not been permanently inhabited. A fisherman lived on West Island for a number of years, and sheep herders occupied the island at least temporarily in the early part of this century. A lighthouse on East Island is presently manned by a small crew of Coast Guardsmen.

The steep south slopes of the islets are covered with dense growths of prickly-pear cactus, *Opuntia oricola*. There are also scattered clumps of this cactus on the tops of the islands, especially along the ridges, as on Middle Island. The northern slopes support moderately dense growths of shrubs, which seem to be spreading on the top of West Island. These shrubs are particularly conspicuous at the heads of the arroyos which lead down the north slopes (fig. 2). The relatively flat tops of the islands are grassland with stands of giant coreopsis, *Coreopsis maritima*. The larger stands of coreopsis (fig. 3), many of which extend onto moderately steep slopes, usually have little other vegetation in association. There are on the West Island a few tree-filled arroyos, with live oak, *Quercus tomentella*, being the most prominent species.

The vegetation of Anacapa Island is probably much disturbed from what must have been the original condition. The introduction of sheep was followed by the introduction of exotic grasses for forage. The combination of these factors probably has led to the elimination of some native plant species, and may have altered the soil conditions as well. A grove of eucalyptus trees on Middle Island certainly presents an environmental niche not present originally. Dunkle (1950) discussed the ecology of the Channel Islands in general, and commented on the various disturbing factors.

Anacapa Island was probably already considerably changed from its original state at the time the first biologists studied there; even the earliest information available does not deal with a "virgin" fauna. It is important to keep in mind that the changes that we can document are not related to change from the original to a disturbed environment, but from one disturbed environment to another.

Fig. 2 (above). Heavy brush at head of tree-filled arroyo on West Anacapa Island. July, 1963.

Fig. 3 (below). Giant coreopsis and grassland on top of West Anacapa Island. July, 1963.

Abbreviations used in this report for depositories of specimens are as follows: LACM, Los Angeles County Museum of Natural History; LBSC, Long Beach State College; MVZ, Museum of Vertebrate Zoology, University of California, Berkeley; SDNHM, San Diego Natural History Museum; UCLA, Dickey Collection, University of California at Los Angeles. The number of specimens examined and their depositories are indicated at the end of the individual species accounts.

Acknowledgments

This study was carried out under contract with the Western Region of the National Park Service. I want particularly to thank the personnel of the Channel Islands National Monument for their assistance and cooperation during the study. Mr. Thomas Tucker, Superintendent, arranged for permits to collect on the island, and was helpful in providing both opportunities to get to the island and transportation. Rangers Thomas Hartman, Jerry Lee, Clinton Collier, and Stanley Williams were gracious hosts during my stays on the island in 1963 and 1964, and assisted in the gathering of data. Lionel Bienvenu provided much necessary historical background.

Dr. M. Dale Arvey, formerly of Long Beach State College, told me of the collection of birds which he had obtained on Anacapa Island, and gave me permission to use them freely; Dr. Ross Hardy of that institution made the specimens available for study. I was able to study the material in the Los Angeles County Museum of Natural History through the courtesy of Dr. Kenneth E. Stager and James R. Northern. I have also examined material in the Museum of Vertebrate Zoology and in the Dickey Collection at the University of California, Los Angeles.

I thank Waldo G. Abbott for sharing his observations. Sidney B. Peyton sent me data from egg sets in his collection. Allan J. Sloan provided me with references to the herpetofauna of the island. A calculator was made available by John Vreeland of Friden, Inc., San Diego.

Dr. Kenneth E. Stager carefully read the manuscript and made a number of helpful suggestions.

Biological Study of Anacapa Island

The earliest reference to Anacapa Island in the biological literature, as far as I have been able to determine, is that by Holder (1899), who reported the presence of a large pelican colony observed from his passing vessel. The first expedition on which biologists spent some time on the island was in June, 1899 (Swarth, 1899). From that time until at least 1915, trips to Anacapa and the other Channel Islands were made more or less regularly by southern California biologists. From references in the literature and from specimen evidence I have been able to determine that Anacapa was visited in the years 1903, 1906, 1909-1913, 1915, and 1917 (Willett, 1910, 1912, 1933; Van Denburgh, 1905; Burt, 1911; Wright and Snyder, 1913; Van Denburgh and Slevin, 1914; Howell, 1917). With a few minor exceptions, the ornithological work mentioned above was summarized in Howell's (1917) study of the birds of the Channel Islands. That paper has served as a taking-off point for the present survey.

After 1915 there is a long gap with no field work on Anacapa Island reported in the literature. The next evidence of any work there consists of specimens (SDNHM) taken by J. E. Green on May 6, 1938. Lowell Sumner and Richard M. Bond of the National Park Service visited Anacapa Island in April, 1939. Sumner's report of this trip, on file at the headquarters of the Channel Islands National Monument, San Diego, includes a list of the birds, mammals, and reptiles that they found on the island. Bond was also on the island May 15-17, 1940. A few specimens of vertebrates taken on each of these trips are deposited in the Museum of Vertebrate Zoology.

The Los Angeles County Museum Channel Islands Biological Survey, begun in 1939, included trips to Anacapa Island in mid-August, 1940, and mid-March, 1941. George Willett and Jack C. von Bloeker, Jr., collected both birds and mammals on these visits. This work led to the description of the endemic form of white-footed mouse (von Bloeker, 1941). Presumably also obtained on the expeditions of this survey were specimens of the slender salamander later discussed by Hilton (1945).

From November 22-24, 1956, and again from August 13-20, 1958, M. Dale Arvey led groups of students from Long Beach State College on trips to Anacapa Island. In the course of these two visits a collection of 63 bird specimens and 21 mammal specimens was amassed. Thirty-three species of birds were included in this collection, of which only eight had been listed in Howell's (1917) compilation. This collection has played an important part in the preparation of the present report.

In recent years, Waldo G. Abbott of the Santa Barbara Natural History Museum has led groups on trips to the vicinity of Anacapa and other Channel Islands, specifically for the observation of sea birds. As far as I am aware, none of these parties has landed on Anacapa. Abbott's observations from May 24, 1964, have been helpful in compiling this report.

My first visit to Anacapa Island, with rangers Thomas Hartman and Clinton Collier, extended from July 27 to August 2, 1963. Fourteen birds and 14 mammals were taken as specimens during the week (SDNHM), on West and Middle islands. In 1964, I spent the period July 22-29 on Anacapa, with rangers Jerry Lee and Stanley Williams. All three islets were visited during this time, with some collecting on each. Particular effort was directed toward surveying the islands for sign of rats, in order to judge the population level and distribution of that introduced rodent. Thus 57 mammal specimens were taken, but only five birds. In addition to work on the islets themselves, we twice during the week circuited the island to observe sea birds in the nearby waters. I spent two hours on East Island, May 5, 1965.

Although beyond the scope of this report, mention should be made of paleontological and geological work on Anacapa Island; for details and references, see Lipps, 1964. Dunkle (1950) summarized botanical researches on the Channel Islands in general.

Amphibians and Reptiles

Batrachoseps attenuatus pacificus. Slender Salamander. — This salamander is not common on the island, and may be restricted to a few canyons. Both Hilton (1945) and Hendrickson (1954) mentioned specimens from Anacapa, but with no detail on when, by whom, or where they were obtained.

Uta stansburiana hesperis. Side-blotched Lizard. — Although not common, this is the more abundant of the lizard species. I saw it in 1963 but not in 1964. Specimens were obtained as early as 1903 (Van Denburgh, 1905). (MVZ)

Gerrhonotus multicarinatus multicarinatus. Alligator Lizard. — This species is not common on the island. (MVZ)

Birds

An asterisk (*) before a name indicates that the species has not been reported from Anacapa Island previously.

Oceanodroma homochroa. Ashy Petrel. — Sumner listed this species in 1939, but without comment on its status. The remains of an unidentified petrel were noted on East Island in 1912 (Wright and Snyder, 1913). There is no evidence that any petrels have nested on the island.

Loomelania melania. Black Petrel. — This species was common at sea in June, 1910 (Willett, 1910); see comments under ashy petrel.

Pelecanus occidentalis. Brown Pelican. — These large birds are known to have nested on Anacapa since at least 1898 (Holder, 1899). Early reports mention colonies on East Island but, as Willett (1910) pointed out, the birds do not necessarily use the same colonial site in succeeding years and they may not nest on the island every year. Thus in 1899 and 1912, nesting was not attempted or was at a very low level, while in 1898, 1910, and 1911, the colony on East Island was active. Howell (1917) correctly summarized that "the island has been occupied by the birds in some years, and vacant in others."

Nesting begins in late spring. In March, 1911, "A number of pelicans were noted flying with long strips of sea weed in their bills, for mending the old nests, but none of them had begun to lay eggs" (Burt, 1911). In 1910, "eggs from fresh to advanced incubation, and young birds from newly hatched to nearly full grown" were found in early June (Willett,

1910). The colony "appeared to be occupied by old birds and two-thirds grown birds" in mid-August, 1898 (Holder, 1899). On July 29, 1963, and July 23, 1964, there were eggs and young in nearly all stages.

At present, pelicans do not nest on either East or Middle islands, the only colony being on West Island. The colony in 1964 seemed to be to the east of the center of activity in 1963. In 1964 the colony stretched over three arroyos and intervening ridges on the north side of the island, and several hundred occupied nests were observed. There has apparently been little change in the size of the population since the earliest reports.

Phalacrocorax spp. Cormorants. — The three species of southern California are lumped together here because of the general similarity of their nesting and other habits and because of the difficulty of certain identification, especially when the birds are seen at a distance. The three are the double-crested, *P. auritus*, Brandt's, *P. penicillatus*, and pelagic, *P. pelagicus*.

All three species were reported nesting on Anacapa Island in the early part of the century, but details are scanty. Estimates of abundance range from a few pairs to quite a number, depending on the season and year, but Brandt's seems to be the least commonly reported.

Cormorants typically nest on the steep cliffs of the island; ledges over the mouths of sea caves seem to be especially favored, according to early reports. In 1964 there were cormorant colonies on cliffs on the west end of West Island, but which species were involved could not be determined. My notes indicate that cormorants were fairly abundant around East Island.

Sumner listed both Brandt's and double-crested cormorants in 1939, but did not list the pelagic cormorant. My notes for late July of 1964 omit mention of *P. pelagicus*, whereas the other species were identified with certainty. W. G. Abbott saw both double-crested and Brandt's cormorants in May, 1964, but did not mention the pelagic. The latter species is distinctively marked during the breeding season, and should be noticed if present. Further observation on the composition of the population of cormorants on Anacapa Island would be desirable. It is doubtful that the overall population has changed much in recent years.

**Buteo jamaicensis*. Red-tailed Hawk. — This species was observed soaring over West Island on several occasions in 1963 and 1964; Stanley Williams saw three at once on July 23, 1964. The birds probably wander over from the larger islands to the west, and perhaps from the mainland.

Haliaeetus leucocephalus. Bald Eagle. — In 1917, Howell wrote that "Several pairs are resident on Anacapa . . ." More specifically, Willett (1910, 1912) found "several" nests with young in 1910, and Burt (1911) reported three occupied nests. There are no reports of eagles in recent years, and the species is certainly no longer resident. The date of elimination of eagles from Anacapa cannot be determined, and the reason for it can be little but conjecture.

Circus cyaneus hudsonius. Marsh Hawk. — Burt took a specimen on Anacapa on March 15, 1911 (Burt, 1911; Willett, 1933).

**Pandion haliaetus*. Osprey. — Sumner listed this bird among those observed in 1939.

Falco peregrinus. Peregrine Falcon. — Peregrines were never very abundant on Anacapa, to judge by early reports, although at least one pair probably nested there (Burt, 1911). The species was most recently reported by Sumner in 1939. It was not noted in 1963 or 1964.

Falco sparverius. Sparrow Hawk. — Burt (1911) reported a pair of these birds on Anacapa in March, 1911. I saw the species on all three islets in 1963 and 1964. Probably at least one pair, and perhaps two or three, are resident, although breeding by this species has never been established.

Haematopus palliatus. American Oystercatcher. — This species has been recorded but once on Anacapa Island, on May 24, 1964 (Abbott, 1965).

Haematopus bachmani. Black Oystercatcher. — Howell (1917) and writers before him reported this bird nesting on Anacapa in small numbers. Such is apparently still the case. In both 1963 and 1964, groups of two to five individuals were seen on numerous occasions in late July. Although Howell (1917:52) indicated that oystercatchers nest on the islands in mid-May, Swarth's (1899) original report of the species from Anacapa noted that specimens secured in early June were not breeding.

Arenaria melanocephala. Black Turnstone. — This bird is present as a spring and fall migrant, and probably throughout the winter. Specific records are for March, April, and late July. (LACM, 2)

Actitis macularia. Spotted Sandpiper. — This is a migrant in both spring and fall; records are for April and August. (LACM, 1)

**Tringa solitaria cinnamomea.* Solitary Sandpiper. — There is one record of this species on East Island in August. (LACM, 1)

Heteroscelus incanum. Wandering Tattler. — This species is a migrant and perhaps winter visitant, with records in April, July, and November. (LACM 1, LBSC, 1)

**Limnodromus griseus* ssp. Short-billed Dowitcher. — This species has been recorded once, on West Island in August. (LACM, 1)

Larus occidentalis. Western Gull. — Willett (1910) and Wright and Snyder (1913) found nesting colonies of this gull on Anacapa Island. The former found eggs and young in early June, and the latter reported only young in early July. W. G. Abbott reports that on May 24, 1964, "The western gulls were definitely on nests as we were able to view them at close range on the steep cliffs" (in litt). Birds were on nests as early as May 5, 1965. On my visits to Anacapa Island in late July I have seen many large, essentially full-grown young western gulls along the water's edge. In the absence of definite information on numbers, either earlier or present, it is impossible to comment on any change in the population. It is unlikely that there has been any significant change.

Cepphus columba. Pigeon Guillemot. — This bird formerly nested on Anacapa Island, perhaps in considerable numbers although no early population estimates are available. Wright and Snyder (1913) specifically mention four nests with partly grown young in early July, 1912. Howell (1917) quotes Dickey as finding guillemots "nesting in almost every tidal cave" with young in most of the nests in late June, 1913.

The pigeon guillemot was included on the list of birds seen by Sumner in 1939. I did not observe the species in late July of either 1963 or 1964, or in early May, 1965. W. G. Abbott did not mention it among the birds seen in May, 1964. The recent lack of observations of a conspicuous bird which would not likely be overlooked suggests that this species no longer inhabits Anacapa Island or does so in reduced numbers.

Endomychura hypoleuca scrippsi. Xantus' Murrelet. — There is some uncertainty in the literature as to the status of this bird on Anacapa Island in former years. Although Willett (1910) saw the birds in waters around the island in June, 1910, he could find no nests. Later (Willett, 1912), he reported that H. C. Burt took eggs of Xantus' Murrelet in May, 1911. The only other report is that D. R. Dickey and A. J. van Rossem found the bird to be "not uncommon" at Anacapa in the spring of 1913, but whether as a nesting bird is not indicated (Howell, 1917). There are three murrelet egg sets from Anacapa Island in Sidney B. Peyton's collection, with the following data: May 15, 1910, 3 eggs, H. B. Webster; May 15, 1911, 1 egg, H. C. Burt; June 11, 1915, 2 eggs, S. B. Peyton.

There are available four specimens (SDNHM) taken by J. E. Green on May 6, 1938, but there is no indication of the breeding status on the labels. This species was not listed by Sumner in 1939. W. G. Abbott recorded this species near the island in May, 1964. I saw no birds nor evidence of nesting on my visits to the island. This evidence suggests that Xantus' murrelet nests on Anacapa in some years, but perhaps not every year and probably only in small numbers. (SDNHM. 4).

Ptychoramphus aleutica. Cassin's Auklet. — There is no direct evidence that this bird ever nested on Anacapa Island. Willet found the birds common on the night of June 5, 1910, and surmised that they were breeding there, but he did not find the colony (Willett, 1910; Howell, 1917). Other authors have not reported the species on the island. Since the nesting season extends into mid-July (Howell, in Bent, 1919) one might well expect to note the species in the vicinity of a nesting colony in the late part of that month, the time that I visited Anacapa. Although I am familiar with the species' call as it comes to land at night, I have no record of the bird for either 1963 or 1964. This bird probably does not nest on Anacapa Island at present, and perhaps never did.

Lunda cirrhata. Tufted Puffin. — Willett (1910) reported that these birds were nesting on the cliffs on Anacapa Island on June 4, 1910, but does not mention specific areas. Wright and Snyder (1913) observed great numbers near the east end of the island in 1912; on July 5 the few nests that were accessible to them contained young birds, the egg season being past. Puffins are fairly large and conspicuous birds, and should be observed easily if nesting in cliff-side colonies. However, Sumner did not list them in 1939, and I did not see them in either of my observation periods in late July, 1963 and 1964. The colony may no longer exist on Anacapa. (UCLA, 1)

**Zenaidura macroura marginella.* Mourning Dove. — The dove has been observed in small numbers, one or two individuals at a time, on each of the islets. They may nest on West or Middle Island. (LBSC, 1)

Tyto alba. Barn Owl. — Willett (1912) and Howell (1917) reported that one had been collected on Anacapa Island. Coast Guard personnel in 1963 mentioned having seen a large white owl, which was probably of this species. One or a few pairs may reside on the island, at least at times.

Speotyto cunicularia. Burrowing Owl. — Burt (1911) was told that burrowing owls had been seen on Middle Island on several occasions. There is no evidence that it occurred there as a nesting species. None was seen in 1963 or 1964, although Sumner saw some in 1939.

Phalaenoptilus nuttallii californicus. Poor-will. — There is a single record, for April. (LACM, 1)

**Chordeiles acutipennis texensis.* Lesser Nighthawk. — I flushed one on East Island, July 26, 1964. Specimens have been taken in August. This species may breed on the island. (LBSC, 2)

Aeronautes saxatalis saxatalis. White-throated Swift. — This species probably nests on Anacapa Island in small numbers. There are records available from March through late July. (LACM, 1)

Selasphorus sasin sedentarius. Allen's Hummingbird. — Hummingbirds are fairly common, especially in the canyons of West Island. (MVZ, 2; LBSC, 2; LACM, 14)

**Colaptes auratus.* Red-shafted Flicker. — This species was reported by Sumner in 1939. The nomenclature used here follows Short, 1965.

**Tyrannus verticalis.* Western Kingbird. — Kingbirds appear as vagrants in late summer. (LBSC, 1; SDNHM, 1)

**Myiarchus cinerascens cinerascens.* Ash-throated Flycatcher. — There are records of this species in April, late July, and August, probably all migrant individuals. (LBSC, 7)

**Sayornis nigricans semiatra.* Black Phoebe. — The black phoebe may be present the year around, but in very small numbers. A specimen from West Island, March 18, is marked as a breeding bird, and nesting probably occurs on East Island as well. Other records are for July and November. (LACM, 1; LBSC, 1)

**Sayornis saya saya.* Say's Phoebe. — Records from March and November are available for this migrant species. (LACM, 1; LBSC, 2)

**Empidonax traillii brewsteri.* Traill's Flycatcher. — This species has been recorded as a fall migrant. (LBSC, 2)

**Empidonax difficilis difficilis.* Western Flycatcher. — These birds were fairly common in the tree-filled ravines near the west end of West Island in 1963. The breeding population must be quite small, however, as the suitable habitat is limited to a few such canyons. The birds are present at least from April to August. Howell (1917) did not list this species, although Lelande had taken a specimen in 1906. (LBSC, 2; LACM, 1; SDNHM, 1)

**Contopus sordidulus* ssp. Western Wood Pe Wee. — This species is known on the island as a fall migrant. The one specimen available is a very dark individual whose racial allocation is uncertain. (LBSC, 1)

Eremophila alpestris insularis. Horned Lark. — Burt (1911) and Willett (1910) both reported the horned lark as among the most common land birds on Anacapa Island. The single specimen available, taken March 16, 1941, on Middle Island, is marked as a breeding

bird. I heard larks on East Island in July, 1964, but could not locate what seemed to be a small flock. Horned larks probably still nest on Anacapa, but perhaps in numbers reduced from earlier years. The population level may vary from year to year depending on the condition of the vegetation on this and the other islands. (LACM, 1)

**Tachycineta thalassina.* Violet-green Swallow. — At least one individual of this species was flying over West Island with barn swallows on July 25, 1964.

Hirundo rustica erythrogaster. Barn Swallow. — This species was reported nesting on July 1, 1912, by Wright and Snyder (1913). A male marked "near breeding" was taken on West Island in mid-March. In 1963 and 1964 the barn swallow was common on all three islets, and was nesting just inside the entrance to Sea Lion Cave on West Island in late July. (LACM, 1; LBSC, 3; SDNHM, 1)

Corvus corax. Common Raven. — Burt found a nest ready for eggs on March 17, 1911, and was sure that there was only one pair on the island (Howell, 1917). I did not see this species on Anacapa; it is probably an occasional visitant and sporadic nester.

**Troglodytes aedon parkmanii.* House Wren. — This is a spring and fall migrant, with records in April and August. (LACM, 2; LBSC, 1)

**Thryomanes bewickii nesophilus.* Bewick's Wren. — Although O. W. Howard obtained specimens on Anacapa Island in 1906, this wren was not listed by Howell (1917) and there is no other indication of its presence until Sumner's list of 1939. Specimens of March, 1941, are marked as breeding birds. I found Bewick's wrens to be fairly common on West Island, especially in the denser brush near the top, in 1963, and considered it to be the most common land bird on that islet in 1964. Specimens obtained in late July were immature birds. (LACM, 5; SDNHM, 5)

Salpinctes obsoletus obsoletus. Rock Wren. — Howell's (1917) summary classed the rock wren as common, and reported a set of eggs taken April 30, 1906. Willett (1910) considered this one of the three commonest land birds in 1910. I saw rock wrens in both 1963 and 1964 on West Island, but did not consider them to be particularly common. (LACM, 4; LBSC, 2; SDNHM, 1)

Mimus polyglottos leucopterus. Mockingbird. — Howell (1917) reported only that the mockingbird occurs on Anacapa. There are records from July and August, probably of post-breeding wanderers. (LBSC, 1)

**Regulus calendula cineraceus.* Ruby-crowned Kinglet. — There is a record for November, 1957. (LBSC, 2)

Lanius ludovicianus anthonyi. Loggerhead Shrike. — A pair of these shrikes with a nest full of young on June 4, 1899 (Howell, 1917) is the only nesting record for Anacapa Island. There are additional reports for April, July, and August. Probably not more than one or two pairs are resident. (LACM, 1; LBSC, 1)

**Vireo gilvus swainsoni.* Warbling Vireo. — This vireo is recorded as a fall migrant. (LBSC, 3)

Vermivora celata sordida. Orange-crowned Warbler. — Howell (1917) reported that these birds nest on Anacapa Island in limited number, and records a set of eggs taken on April 6, 1906. Other records cover the period of March through August. I have seen them on all three islets. On May 5, 1965, a female with a brood patch flushed from a light growth of ice plant and coreopsis, but the nest could not be found. The nesting population on Anacapa is probably not large. (LACM, 13; LBSC, 3; MVZ, 2; SDNHM, 1)

**Dendroica petechia* ssp. Yellow Warbler. — This is apparently a fairly common fall migrant. (LBSC, 5)

**Dendroica nigrescens.* Black-throated Gray Warbler. — There is one August record for this species. (LBSC, 1)

**Oporornis tolmiei tolmiei.* MacGillivray's Warbler. — Migrants of this species have been noted in August. (LACM, 1; LBSC, 2)

**Wilsonia pusilla chryseola.* Wilson's Warbler. — This warbler is a migrant in both spring and fall, with records in April and August. (LBSC, 2; MVZ, 1)

Sturnella neglecta. Western Meadowlark. — Meadowlarks occur on all three islets, perhaps more commonly in winter. Howell (1917) quotes Burt as reporting meadowlarks to be very common in 1911. I saw a few on each islet in July of 1963 and 1964, but they were not common; in early May, however, this was the most conspicuous bird on East Island. A specimen taken in late July was in heavy molt. (LBSC, 2; SDNHM, 1)

**Xanthocephalus xanthocephalus.* Yellow-headed Blackbird. — This species has occurred as a vagrant, with one record in August. (LBSC, 1)

**Icterus cucullatus.* Hooded Oriole. — One individual of this species was seen on West Island in July, 1963.

**Icterus bullockii.* Bullock's Oriole. — There are two records of this species, in late July and August. (LBSC, 1)

**Molothrus ater obscurus.* Brown-headed Cowbird. — Cowbirds were seen on both West and Middle islands in July, 1963. (SDNHM, 1)

**Piranga ludoviciana.* Western Tanager. — This species has occurred in July and August. (LBSC, 1)

**Pheucticus melanocephalus maculatus.* Black-headed Grosbeak. — There is one fall record from East Island. (LACM, 1)

Carpodacus mexicanus frontalis. House Finch. — Howell (1917) considered the house finch to be an abundant resident on Anacapa as well as the other Channel Islands. Willett (1910) listed it as one of the three most common species. Although I saw or heard this species on West Island in both 1963 and 1964, I did not consider it to be particularly common. (LACM, 3; LBSC, 1)

**Passerculus sandwichensis* ssp. Savannah Sparrow. — This species occurs as a migrant, probably regularly, in both spring and fall. Records are available for March, April, May, and August. Howell (1911) did not list this species, although Lelande had taken a specimen in 1906. (LACM, 3; LBSC, 2; MVZ, 1)

**Aimophila ruficeps obscura.* Rufous-crowned Sparrow. — The first record for the island is for August, 1940; it may have been overlooked previously, or it may be a recent addition to the island's fauna. I found many of these birds on West Island in 1963 and 1964, and on Middle Island in 1964. At present I consider it to be among the more common passerine species. Several juveniles are among the specimens available. (LACM, 1; LBSC, 1; SDNHM, 5)

**Junco oreganus thurberi.* Oregon Junco. — A single individual of this species was seen on East Island, May 5, 1965. (SDNHM, 1)

**Spizella passerina arizonae.* Chipping Sparrow. — Like the rufous-crowned sparrow. the chipping sparrow was not reported on the island until 1940; in that year a specimen was taken on Middle Island. I saw chipping sparrows only on West Island where in late July of 1963 there seemed to be young of two ages. They were less frequently noted in 1964, but at least one family group was present. (LBSC, 2; MVZ, 1; SDNHM, 3)

**Zonotrichia leucophrys gambelii.* White-crowned Sparrow. — This is a regular visitor in spring and fall, with some perhaps spending the winter. This species was not listed by Howell (1917) although Lelande had taken a specimen in 1906. (LACM, 2; LBSC, 1)

**Zonotrichia atricapilla.* Golden-crowned Sparrow. — This species appears as a spring and fall migrant. (LACM, 1; LBSC, 1)

Terrestrial Mammals

Oryctolagus cuniculus. European Rabbit. — Rabbits were introduced on East Island, I am told, to serve as an emergency food supply for personnel of the Coast Guard Light Station there during World War II. It is also reported that the introduction resulted from escaped pets (K. E. Stager, pers. comm.). Their numbers have fluctuated widely over the years. In 1963 they were uncommon, and in 1964 and 1965 there were but a few rabbits on the cliffs near the east end of the island. The rabbits have done considerable damage to the original vegetation structure of the island (see Dunkle, 1950:263). There are no rabbits on the other two islets.

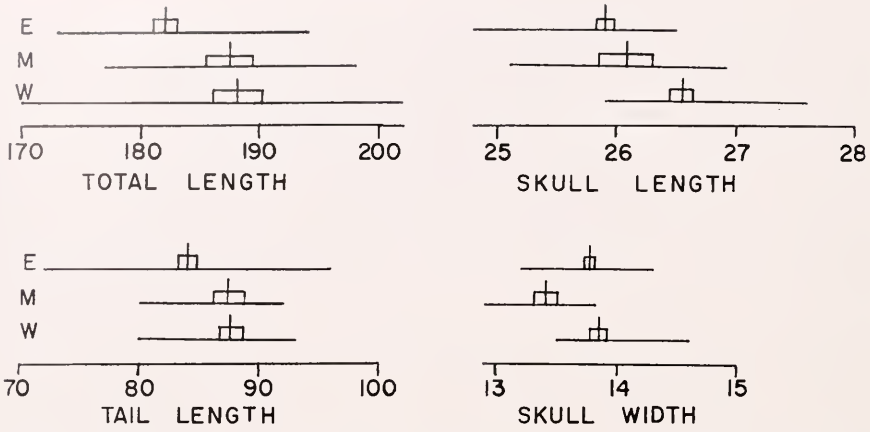

Fig. 4. Diagrammatic presentation of ceratin measurements of *Peromyscus maniculatus anacapae* on East, Middle, and West islets of Anacapa Island.

Horizontal lines indicate range, vertical lines are means, and boxes extend one standard error to either side of the mean.

Peromyscus maniculatus anacapae. White-footed Mouse. — This is the only mouse present on the island; it is common on all three islets, although its abundance may vary from year to year depending on rainfall and resultant vegetation. Mice seem to occur in all habitats. On West Island they were captured in heavy brush, grassy areas, and at the edge of the Opuntia-covered slope. They were least abundant in a dense stand of tall oats (*Avena*). Many trails through the grass atop West Island were originally attributed to rats, but traps set in or near the runways or in the holes to which they led captured only mice. Cut grass stems were abundant along the runways and in cracks and holes in the hard soil. On Middle Island the mice were apparently absent from the eucalyptus grove, but were captured both in grassy areas and coreopsis "forest." On East Island they were particularly common around clumps of prickly pear cactus.

In late July, 1963, the mice on West Island were breeding. One female had five 3 mm. embryos, although two were recorded as having none. A male had testes 10 mm. in length. Gray-pelaged young, about half grown, indicated that breeding had taken place for several weeks previously. Indications from the small sample obtained on Middle Island that year suggested the same timing of breeding. In 1964, however, breeding seemingly had ceased somewhat earlier on West Island. Four females taken July 23 were specifically recorded as having no embryos. Only one male had testes as large as 10 × 6 mm., whereas seven others had testes from 3 × 2 to 6 × 4 mm. Half-grown young indicated that breeding had taken place a month or six weeks previously. On Middle and East islands in 1964, breeding was actively in progress at the time it had ceased on West Island. Males had gonads in the 10 × 6 mm. size range, none showing the regression that had occurred on West Island. Some females were recorded with no embryos, but over two-thirds of the sample were pregnant or lactating; embryos ranged in size from 3 to 22 mm. Partly grown young, about the same size as those found on West Island, were also present. For some reason, then, breeding continued longer on East and Middle islands in 1964 than it did on West Island.

There is incipient differentiation between the populations of mice on the three islets (table 1, fig. 4). The mice on East Island average approximately 6 mm. shorter than those on the other two islands, the difference being a result of both a shorter tail and a shorter head and body. The populations on Middle and West islands are very similar to one another in all these measurements. Although the means of the measurements of body size set the population on East Island apart from the others, the extent of overlap and the rather high degree of variability within the populations on Middle and West islands, as indicated by the large standard errors, preclude any formal taxonomic recognition of the populations at present.

Table 1

Measurements (in mm.) of *Peromyscus maniculatus* on the islets of Anacapa Island. Adults of both sexes are included in the samples. N, sample size; M, mean; SE, standard error; R, range.

	EAST				MIDDLE				WEST			
	N	M	SE	R	N	M	SE	R	N	M	SE	R
Total length	43	182.0	.9	174-194	10	187.4	2.17	177-198	16	188.3	2.06	170-202
Tail length	43	84.05	.76	72-96	10	87.6	1.26	80 92	16	87.75	.99	80-93
Head and body length	43	97.91	.44	92-105	10	99.8	1.26	95-107	16	100.56	1.26	90-110
Skull length	43	25.90	.07	24.8-26.5	9	26.07	.23	25.1-26.9	16	26.55	.105	25.9-27.6
Skull width	40	13.77	.04	13.2-14.3	9	13.4	.105	12.9-13.8	15	13.85	.77	13.5-14.6

The measurements of the greatest length and greatest width of the skulls present a somewhat different pattern of variation, in that the population on Middle Island is not consistently similar to that on West Island. In fact, the Middle Island population has a distinctly narrower skull than the others, and the one on West Island has a distinctly longer one. Plotting these two characters on a scatter diagram reveals a fair separation, from 66 to 90 per cent, of any two of the populations. Eleven per cent of the measurements fall into the zone where all three populations overlap.

Although the differences between the populations do not seem great enough for formal recognition at present, they are interesting in relation to the presumed history of the island. The three islets are separated now, but undoubtedly were joined in the recent past. The gap between East and Middle islands is broader and deeper, and presumably older, than that between Middle and West islands. It is probably significant that, at least in external characters, the mice on East Island are the most distinct. This population rather obviously represents the first isolation from the original stock. However, the more recent and perhaps still incomplete isolation of the population on West and Middle islands has permitted some differentiation, as evidenced by the skull measurements.

It will be interesting to study these populations of mice at intervals in the future in an attempt to trace the progress of the changes noted here. (LACM, 89; LBSC, 19; MVZ, 1; SDNHM, 62)

Rattus rattus ssp. Black Rat. — This rat has been introduced on all three islets, but the time of the introduction cannot be determined. The first specimens were obtained by Bond (MVZ) in 1940, and there are no reports of their presence in the earlier literature.

In 1963, rats were abundant around the ranger station at Frenchy's Cove on West Island. On the coreopsis-covered slopes nearby, many of the mice and rats captured in traps during the night were badly chewed in the morning, presumably by rats. In this area in 1964, rats seemed to be less common, but several were seen at night in the vicinity of the station and the beach at Frenchy's Cove. Stanley Williams reportd his impressions that the rats in the vicinity of the ranger station were less abundant in 1963 and 1964 than they had been in the summer of 1962.

On Middle Island, rats were abundant in 1963 and 1964 at the edge of the eucalyptus grove, particularly in the tall grass and deep gullies. In shorter grass and in coreopsis, trapped mice showed none of the damage attributed to rats on West Island. However, on the ridge of Middle Island, in rather bare soil near the cactus-covered south slope, several trapped mice had been partly eaten.

The scanty information available from five skins saved from trapping in late July of 1963 and 1964 suggests a breeding season extending at least from June to August. Juveniles approximately one-sixth (45 gm.) and one-third (85 gm.) grown were captured in late July. An adult female taken at that time contained seven embryos 10 mm. long, and another was lactating. Males at that time had testes measuring from 21 × 11 to 25 × 12 mm. Weights of adult males ranged from 204 to 347 gm. (LBSC, 2; MVZ, 2; SDNHM, 6)

Felis domesticus. Cat. — "Frenchy", a fisherman who lived for many years at the cove on West Island which now bears his name, had a fondness for cats, and kept a number as pets. They remained on the island when he left, and presumably are the progenitors of the

feral population now present. The population is probably not large, and awareness of its presence is based on the presence of scat rather than on observations of the animals.

Ovis aries. Sheep. — Sheep were grazed on the island for many years; exact dates are not available (see Dunkle, 1950:261, 268). Forage grasses were introduced for their benefit, considerably altering the vegetation structure of the islands. Additionally, the soil-compacting action of their sharp hooves probably changed the structure of the ground, which would also have an effect on the plants. The effect of grazing would be detrimental to ground-nesting birds, such as the Meadowlark and Horned Lark, and the soil compaction would be destructive to burrowing species.

Changes in Bird Populations

There have been a number of events in the recent history of Anacapa Island, related to man's activities, which could have had some effect on the resident or nesting avifauna. Among these are the introduction, and later the removal, of sheep, the introduction of rabbits and rats, and the presence of feral house cats. Since there are no good estimates of the sizes of the bird populations either from the early part of the century or from recent years, any comments on changes in populations must be considered conjectural.

It is somewhat difficult to say that an undisturbed condition ever existed on Anacapa Island. The Canalino Indians lived on the island for an unknown number of years (or centuries) before the coming of the white man, and it would be surprising if they did not feed to some extent on the eggs of some of the larger birds. Soon after the coming of the European settlers, sheep were introduced on the island. It is unfortunate that (apparently) sheep got there before the first biologists. It is impossible to determine what effect the sheep, or the exotic grasses introduced for their forage, had on the vegetation or fauna of the island. The sheep have been removed, and the vegetation is apparently still developing toward a new climactic expression, which will include elements of both the original and introduced floras. Whether the introduction of predators has had an effect on the avifauna or on other vertebrates cannot be determined, but some bird species that apparently did nest on Anacapa formerly apparently do not nest there now. Other environmental factors may bear, or at least share, the responsibility for these faunistic changes.

Increases. — The rufous-crowned sparrow and the chipping sparrow were among the most common land birds seen in 1963 and 1964, particularly on West and Middle islands, and both were breeding. I think it is significant that neither of these species was mentioned by writers who visited the island in the early part of the century; the species were first recorded there in 1940, although they may have been present for some years previous. Bewick's wren probably fits into the category of newcomers to the island, despite the fact that two specimens were obtained in 1906; this bird, which is now common, has not previously been mentioned in the literature on birds of the island.

It is probable that the presence of these three species in recent years represents an adjustment of the avifauna to vegetational changes resulting from the cessation of grazing on the island. Bewick's wren and the rufous-crowned sparrow are both primarily chaparral dwellers (Miller, 1951). The unforested habitat is not typical for the chipping sparrow (Grinnell and Miller, 1944:513), and it is probably significant that this is the least abundant of the three apparent newcomers. Very likely the end of grazing by sheep permitted recovery of the shrubby vegetation which provides suitable habitat for these birds (see Dunkle, 1950:268).

Decreases. — Several species of terrestrial passerines — the horned lark, rock wren, house finch, and western meadowlark — seem to be present on Anacapa in smaller numbers now than formerly. The first three were considered by Willett (1910) to be the commonest land birds on the island. The decrease in numbers of horned larks and meadowlarks, which nest in open grassy areas, may be considered a corollary to the increase of Bewick's wren and the sparrows discussed above. As the amount of brush increased after the cessation of grazing, the amount of open grass decreased. Peak numbers of these two species may have occurred when grazing was in progress, which was also when the early ornithological work was done on the island.

Decreases of the rock wren and house finch may be due to predation more than to habitat change. Situations favored by nesting rock wrens are those likely to be investigated by wandering rats. Anthony (1925) regarded cats as the principal factor responsible for the decline of closely related species of house finches on Guadalupe and the San Benito Islands in Baja California, and they may similarly be responsible on Anacapa.

Four species which are dependent on the sea for food seem to be absent from the island now although variably abundant previously. These are the pelagic cormorant, pigeon guillemot, Xantus' murrelet, and tufted puffin. Cassin's auklet may belong in this group also, although there is no convincing evidence that it ever nested on Anacapa. Compaction of the soil by grazing sheep and predation by rats would be detrimental to the murrelet and auklet. However, a change in the distribution of small fish species utilized as food could perhaps account for the decrease in all of these birds.

Two raptorial birds, the bald eagle and the peregrine falcon, are among those species which formerly nested on Anacapa Island but do not do so now. The population decline of these species is widespread and probably results from the interplay of a number of factors, including predation by man. Neither of these birds maintained high populations on Anacapa. Any decrease in the number of medium-sized seabirds, utilized as food, could contribute to the decline of peregrines.

Stable populations. — A few passerine species have apparently maintained fairly constant populations on Anacapa over the years. Their rather infrequent mention in the early literature may indicate rather low densities; if so, the present low numbers are not necessarily indicative of a population decline. The habitat of the western flycatcher and orange-crowned warbler, for example, is rather limited and probably has not changed greatly in extent in the past fifty years.

Among the larger and more aquatic birds, the brown pelican, western gull, double crested and Brandt's cormorants, and the black oystercatcher appear to be approximately as numerous now as formerly.

Summary

The known terrestrial vertebrate fauna of Anacapa Island includes one species of amphibian, two species of reptiles, 69 of birds, and five of mammals. The occurrence of 35 of the bird species is reported here for the first time. Only 28 species of birds are known or presumed to have occurred as nesting species. Only one species of mammal is native, the others having been introduced by man.

A number of factors in the recent history of Anacapa Island must have had important effects on the fauna and flora. The most severe have been the introduction of sheep, the introduction of exotic grasses for forage, the removal of sheep, and the introduction of predators. Several rather poorly documented changes in bird populations are discussed relative to these environmental changes.

There is incipient differentiation between the populations of native white-footed mice on the three islets of Anacapa, as shown by variation in measurements of the skull and external features.

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